Balancing Oxidation-Reduction Reactions

Name : _____

APPLICATION OF PRINCIPLES

1. Show the change in oxidation number (give number of electrons gained or lost *per atom*: e.g., 3*e*-gained) in the following reactions:

(a) $NO_{2}^{-} \rightarrow NO_{3}^{-}$ _____

(b) $SO_2 \rightarrow S_2^{2-}$ _____

(c) $MnO_4^{-} \rightarrow MnO_2$ _____

(d) $KClO_2 \rightarrow KCl$ _____

(e) $CrO_4^{2-} \rightarrow Cr_2O_7^{2-}$ _____

(f) $HCOOH \rightarrow HCHO$ _____

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2. Write the half-reaction equation for the oxidation of

(a) NO_2^- to NO_3^- (acidic) _____

(b) H_2S to SO_4^{2-} (acidic) _____

(c) NH_4^+ to NO_3^- (acidic) _____

(d) H_2O_2 to O_2 (g) (basic) _____

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3. Write the half-reaction equation for the following:

(a) SO_3^{2-} to H_2S (acidic) _____

(b) MnO_4^{1-} to MnO_2 (basic) _____

(c) HO_2^- to OH^- (basic) _____

(d) HCOOH to CH_3OH (acidic) _____

4. Write the half-reaction equation for the following:

(a) $Cr(OH)_4^-$ to CrO_4^{2-} (basic) _____

(b) ClO_3^- to Cl^- (acidic) _____

(c) ClO^- to ClO_4^- (acidic) _____

(d) $Cr_2O_7^{2-}$ to Cr^{3+} (acidic) _____

(e) HCOOH to CO_2 (acidic) _____

(f) CH_3NO_2 to CH_3NH_2 (acidic) _____

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5. Given the reactants and products, write balanced net ionic equations for the following reactions. (Supply H_2O, H^+, or OH^- as needed.)

(a) Iron filings are added to $FeCl_3$ solution.

$$Fe + Fe^{3+} \rightarrow Fe^{2+}$$

(b) Bismuth metal is dissolved in hot concentrated HNO_{3-} and a brown gas is given off.

$$Bi + NO_3^- \rightarrow Bi^{3+} + NO_2(g)$$

(c) A mixture of Na_2S. NaClO. and NaOH solutions is warmed, giving a suspended precipitate.

$$S^{2-} + ClO^- \rightarrow S^0 + Cl^-$$

(d) SO_2 gas is bubbled into $K_2Cr_2O_7$ solution (acidic).

$$SO_2 + Cr_2O_7^{2-} \rightarrow Cr^{3+} + SO_4^{2-}$$

6. Give the formula of a product (derived from the first-named substance) that may be formed in the following reactions. (Note, in the example that any lower oxidation state compound is possible: but not any higher one. Some are more probable than others.)

Example. H_2SO_3 is treated with a reducing agent. S. S_2^{2-}. H_2S

(a) $HClO_2$ is treated with a reducing agent. _____

(b) H_2SO_3 is treated with an oxidizing agent. _____

(c) $SnCl_4$ is treated with zinc dust. _____

(d) $Cr_2O_7^{2-}$ is treated with $SnCl_2$. _____

(e) $KMnO_4$ is treated with $FeSO_4$. _____

(f) MnO_2 is treated with concentrated HCl. _____

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7. Predict the products and write balanced net ionic equations for the following reactions.

(g) $SnCl_2$ is added to $KMnO_4$ solution (acidic) forming Mn^{2+}.

(h) Zinc dust is treated with dilute HNO_3 forming NH_4^+.

(i) Oxalate in CaC_2O_4 is oxidized to CO_2 by $KMnO_4$ in acidic solution, forming Mn^{2+}.